

What is claimed is:

1. A method of determining a control input signal, comprising:

determining a jerk parameter equation, the jerk parameter equation being

$$\sum_{i=0}^N (-1)^{i+1} T_i = \frac{1}{J}$$

determining a first constraint equation, the first constraint equation being

$$\sum_{i=0}^N (-1)^i \exp(-\sigma_k T_i) \cos(\omega_k T_i) = 0 \text{ for } k = 1, 2, 3, \dots$$

determining a second constraint equation, the second constraint equation being

$$\sum_{i=0}^N (-1)^i \exp(-\sigma_k T_i) \sin(\omega_k T_i) = 0 \text{ for } k = 1, 2, 3, \dots$$

determining a set of T_i values that provides a solution for each of (a) the jerk parameter equation, (b) the first constraint equation and (c) the second constraint equation;

selecting the set of T_i values to provide a selected set;

using the selected set to determine a corresponding transfer function according to the following equation;

$$G(s) = \sum_{i=0}^N (-1)^i \exp(-s T_i)$$

coupling the transfer function with a filter to provide an augmented transfer function;

and

acting upon an input signal according to the augmented transfer function to provide a control input signal.

2. The method of claim 1, wherein the transfer function includes a pulse, and an amplitude of the pulse is selected to achieve a desired change in the system upon completion of the control input signal.

3. The method of claim 1, wherein selecting the set of T_i values to provide a selected set is accomplished by:

determining a total time parameter for the selected set, the total time parameter being equal to an amount of time needed to execute the corresponding transfer function; and

comparing the total time parameter of the selected set to determine that the selected set has a smallest total time parameter.

4. The method of claim 1, wherein the set of T_i values provides a solution to a desensitizing equation, in addition to the jerk parameter equation, the first constraint equation and the second constraint equation.

5. The method of claim 4, wherein the desensitizing equation is:

$$\sum_{i=0}^N (-1)^i T_i \exp(-\sigma_k T_i) \sin(\omega_k T_i) = 0 \text{ for } k = 1, 2, 3 \dots$$

and the set of T_i values provides a solution to a further desensitizing equation, the further desensitizing equation being

$$\sum_{i=0}^N (-1)^i T_i \exp(-\sigma_k T_i) \cos(\omega_k T_i) = 0 \text{ for } k = 1, 2, 3 \dots$$

6. The method of claim 1, wherein the filter is an integrator.

7. The method of claim 1, wherein the filter is a first order filter.

8. The method of claim 1, wherein the filter is a sinusoidal filter.

9. A method of determining a control input signal, comprising:

selecting a desired time delay;

determining a jerk parameter equation, the jerk parameter equation being

$$2A_1nT_s + 2A_2mT_s + A_3nT_s = \frac{1}{J}$$

determining a first constraint equation, the first constraint equation being

$$A_1 - (A_1 - A_2)\cos(nT_s\omega) - (A_2 - A_3)\cos((n+p)T_s\omega) - (A_3 - A_2)\cos((n+p+m)T_s\omega) - (A_2 - A_1)\cos((n+2p+m)T_s\omega) - A_1\cos((2n+2p+m)T_s\omega) = 0$$

determining a second constraint equation, the second constraint equation being

$$-(A_1 - A_2)\sin(nT_s\omega) - (A_2 - A_3)\sin((n+p)T_s\omega) - (A_3 - A_2)\sin((n+p+m)T_s\omega) - (A_2 - A_1)\sin((n+2p+m)T_s\omega) - A_1\sin((2n+2p+m)T_s\omega) = 0$$

determining a set that satisfies (a) the jerk parameter equation, (b) the first constraint equation and (c) the second constraint equation, each set comprising a value for each of A1, A2, A3, m, n and p;

selecting the set to provide a selected set;

using the selected set to determine a corresponding transfer function according to the following equation

$$G(s) = A_1 - A_1e^{-snT_s} + A_2e^{-snT_s} - A_2e^{-s(n+p)T_s} + A_3e^{-s(n+p)T_s} - A_3e^{-s(n+p+m)T_s} + A_2e^{-s(n+p+m)T_s} - A_2e^{-s(n+2p+m)T_s} + A_1e^{-s(n+2p+m)T_s} - A_1e^{-s(2n+2p+m)T_s}$$

coupling the transfer function with a filter to provide an augmented transfer function;
and

acting upon an input signal according to the augmented transfer function to provide a control input signal.

10. . The method of claim 9, wherein selecting the set to provide a selected set is accomplished by:

determining a total time parameter for the selected set, the total time parameter corresponding to an amount of time needed to execute the corresponding transfer function; and

comparing the total time parameter of the selected set to determine that the selected set has a smallest total time parameter.

11. The method of claim 9, wherein selecting the set to provide a selected set is accomplished by:

determining a sensitivity factor for the selected set, the sensitivity factor being determined by:

$$f = \sum_{\omega=\omega_l}^{\omega=\omega_h} abs \left(\frac{A_1 (1 - \exp(-nT_s j\omega)) + A_2 \exp(-(n+p)T_s j\omega)(1 - \exp(-mT_s j\omega)) + A_3 \exp(-(n+2p+m)T_s j\omega)(1 - \exp(-nT_s j\omega))}{A_3 \exp(-(n+2p+m)T_s j\omega)(1 - \exp(-nT_s j\omega))} \right)$$

comparing the sensitivity factor of the selected set to determine that the selected set has a smallest sensitivity factor.

12. The method of claim 9, wherein the filter is an integrator.

13. The method of claim 9, wherein the filter is a first order filter.

14. The method of claim 9, wherein the filter is a sinusoidal filter.

15. A method of generating an input to a system, comprising:

determining a jerk parameter equation, the jerk parameter equation describing the rate of change of the acceleration of a component of the system from a first state to a second state;

determining a first constraint equation and a second constraint equation, the constraint equations describing how poles of the jerk parameter equation may be canceled;

determining a set of T_i values that provides a solution for each of (a) the jerk parameter equation, (b) the first constraint equation and (c) the second constraint equation;

selecting the set of T_i values to provide a selected set;

using the selected set to determine a corresponding transfer function according to the following equation

$$G(s) = A_1 - A_1 e^{-sT_s} + A_2 e^{-sT_s} - A_2 e^{-s(n+p)T_s} + A_3 e^{-s(n+p)T_s} - A_3 e^{-s(n+p+m)T_s} + A_2 e^{-s(n+p+m)T_s} - A_2 e^{-s(n+2p+m)T_s} + A_1 e^{-s(n+2p+m)T_s} - A_1 e^{-s(2n+2p+m)T_s}$$

coupling the transfer function with a filter to provide an augmented transfer function;
and

acting upon an input signal according to the augmented transfer function to provide a control input signal.

16. The method of claim 15, wherein selecting one of the sets to provide a selected set is accomplished by:

determining a total time parameter for the selected set, the total time parameter corresponding to an amount of time needed to execute the corresponding transfer function;
and

comparing the total time parameter of the selected set to determine that the selected set has a smallest total time parameter.

17. The method of claim 15, wherein selecting one of the sets to provide a selected set is accomplished by:

determining a sensitivity factor equation, the sensitivity factor equation being able to produce a sensitivity factor indicating an ability of the system to tolerate deviations;

determining a sensitivity factor for the selected set; and

comparing the sensitivity factor of the selected set to determine that the selected set has a smallest sensitivity factor.

18. The method of claim 17, wherein the sensitivity factor equation is

$$f = \sum_{\omega=\omega_l}^{\omega=\omega_h} abs \left(\frac{A_1 (1 - \exp(-nT_s j\omega)) + A_2 \exp(-(n+p)T_s j\omega)(1 - \exp(-mT_s j\omega)) + A_3 \exp(-(n+2p+m)T_s j\omega)(1 - \exp(-nT_s j\omega))}{A_3 \exp(-(n+2p+m)T_s j\omega)(1 - \exp(-nT_s j\omega))} \right)$$

19. The method of claim 15, wherein the filter is an integrator.
20. The method of claim 15, wherein the filter is a first order filter.
21. The method of claim 15, wherein the filter is a sinusoidal filter.